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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/783,498	02/20/2004	Li-Shyue Lai	TSM03-0199	7579

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EXAMINER	
CAO, PHAT X	
ART UNIT	PAPER NUMBER
2814	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/07/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/783,498	LAI ET AL.	
	Examiner	Art Unit	
	Phat X. Cao	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 December 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5,7-11 and 29-38* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *9-11* is/are allowed.

6)☒ Claim(s) *1-5, 7, 8, 29-38* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. The Request for Continued Examination filed on 12/27/06 is acknowledged.

2. The cancel of claims 6 and 12-28 in Paper filed on 12/27/06 is acknowledged.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

2. Claims 1-5, 29-33, and 35-38 are rejected under 35 U.S.C. 102(e) as being anticipated by Lung (US. 2004/0248339).

Regarding claims 1, 29 and 30, Lung (Fig. 10) discloses a phase change memory cell fabricated on a semiconductor substrate 100 comprising: an insulating dielectric layer 400; a thin conductive film 700 having a first film thickness on the dielectric layer 400, the plane of the film 700 being generally parallel to the plane of the dielectric layer 400; a layer of a phase change material 900 (par. [0049]) having a

second film thickness supported by the dielectric layer 400, wherein the phase change material 900 and the thin conductive film 700 are not relatively superjacent; an electrically resistive interface 901 between the thin conductive film 700 and the phase change material layer 900, the interface 901 being defined by an area of engagement between the film 700 and the layer 900 that is generally normal to the plane of the dielectric layer 400, and wherein the thickness of the thin conductive film 700 is less than the thickness of the layer of phase change material 900 at the interface; and an electrode 1100 superjacent to the phase change material layer 900, wherein the portion of the electrode 1100 superjacent the phase change material layer 900 is also in contact with the phase change material layer 900 (claim 1), and wherein the electrode 1100 extending away from the bottom surface of the phase change material layer 900 in a direction generally perpendicular to a major surface of the substrate 100 (claim 29).

Regarding claims 2-3, 5, 33 and 35, Lung's Fig. 10 further discloses that the width of the conductive film 700 generally parallel to the plane of the dielectric layer 400 and the height of the conductive film 700 generally normal to the plane of the dielectric layer 400 determine the area of engagement (claims 2-3 and 35). Therefore, the current path from the interface into the phase change material layer 900 inherently lies in a direction substantially parallel to the plane of the substrate, and the current path from the phase change material layer 900 into the contact 1100 inherently lies in a direction generally normal to the plane of the substrate (claims 5 and 33).

It is noted that the electrical resistance of the interface is inversely proportional to the area of engagement (claims 2) because the conductive resistance is inversely

proportional to the conductive area. It is also noted that the process limitations recited in a "product by process" claims 3 and 35 (determined by photolithography, by deposition parameters) would not carry patentable weight in a claim drawn to structure because distinct structure is not necessarily produced. In re Thorpe, 227 USPQ 964 (Fed. Cir. 1985).

Regarding claims 4 and 32, because the width of the conductive film 700 is parallel to the plane of the substrate, the heat produced by current through the interface 901 would also flow from the interface 901 into the phase change material layer 900 in a direction parallel to the plane of the substrate.

Regarding claims 6 and 31, Lung's Fig. 10 further discloses that the phase change material layer 900 and the thin conductive film 700 are not relatively superjacent or subjacent, and the conductive material 700 comprises a high band gap and high thermal conductivity material of titanium nitride (par. [0051], last 3 lines).

Regarding claim 36, Lung (Fig. 10) discloses a memory cell, comprising: a layer of phase change material 900; and an elongated thin conductive film 700 having one end engaging a side of the layer 900to define an interface 901 having a width and a height, wherein the thin conductive film and the layer of the phase change material engage at an interface and wherein the thin conductive film 700 has a thickness at the interface that is thinner than the phase change material 900 at the interface; an electrode 1100 immediately adjacent the phase change material layer 900 and extending away from the bottom surface of the phase change material 900 in a plane substantially perpendicular to a longitudinal axis of the elongated thin conductive film

700. It is also noted that the process limitations recited in a "product by process" claim (determined non-photolithographically, by thin film deposition parameters)) would not carry patentable weight in a claim drawn to structure because distinct structure is not necessarily produced. In re Thorpe, 227 USPQ 964 (Fed. Cir. 1985).

Regarding claims 37-38, because the width of the conductive film 700 generally parallel to the plane of the substrate and the height of the contact 1100 generally normal to the film 700, the current flows from the interface into the phase change material layer 900 generally parallel to the film 700 and the current flows out of the layer 900 into the contact 1100 generally normal to the film 700.

3. Claims 1-5, 7, 29-34, and 35-38 are rejected under 35 U.S.C. 102(e) as being anticipated by Rodgers et al (US. 2004/0126925).

Regarding claims 1, 29 and 30, Rodgers (Fig. 3E) discloses a phase change memory cell fabricated on a semiconductor substrate 30 comprising: an insulating dielectric layer 32; a thin conductive film 34 having a first film thickness on the dielectric layer 32, the plane of the film 34 being generally parallel to the plane of the dielectric layer 32; a chalcogenide layer of a phase change material 37 (par. [0005]) having a second film thickness supported by the dielectric layer 32, wherein the portion of the phase change material 37 formed within the trench 36 and the thin conductive film 34 are not relatively superjacent or overlap; an electrically resistive interface 39 between the thin conductive film 34 and the phase change material layer 37, the interface 39 being defined by an area of engagement between the film 34 and the layer 37 formed within the trench that is generally normal to the plane of the dielectric layer 32, and

wherein the thickness of the thin conductive film 34 is less than the thickness of the layer of phase change material 37 at the interface; and an electrode 38 superjacent to the phase change material layer 37, wherein the portion of the electrode 38 superjacent the phase change material layer 37 is also in electrical contact with the phase change material layer 37 (claim 1), and wherein the electrode 38 having a thickness extends away from the phase change material 37 in a direction perpendicular to a major surface of the substrate 30 (claim 29).

Regarding claims 2-3, 5, 33 and 35, Rodgers's Fig. 3E further discloses that the width of the conductive film 34 generally parallel to the plane of the dielectric layer 32 and the height of the conductive film 34 generally normal to the plane of the dielectric layer 32 determine the area of engagement (claims 2-3 and 35). Therefore, the current path from the interface into the phase change material layer 37 inherently lies in a direction substantially parallel to the plane of the substrate, and the current path from the phase change material layer 37 into the contact 38 inherently lies in a direction generally normal to the plane of the substrate (claims 5 and 33).

It is noted that the electrical resistance of the interface is inversely proportional to the area of engagement (claims 2) because the conductive resistance is inversely proportional to the conductive area. It is also noted that the process limitations recited in a "product by process" claims 3 and 35 (determined by photolithography, by deposition parameters) would not carry patentable weight in a claim drawn to structure because distinct structure is not necessarily produced. In re Thorpe, 227 USPQ 964 (Fed. Cir. 1985).

Regarding claims 7 and 34, Rodgers's Fig. 3E further discloses that the phase change material layer 37 resides in a trench 36 formed in the dielectric layer 32, the bottom surface of the trench 36 and the phase change material layer 37 being below the upper surface of the dielectric layer 32.

Regarding claims 4 and 32, because the width of the conductive film 34 is parallel to the plane of the substrate, the heat produced by current through the interface 39 would also flow from the interface 39 into the phase change material layer 37 in a direction parallel to the plane of the substrate.

Regarding claims 6 and 31, Rodgers's Fig. 3E further discloses that the portion of the phase change material layer 37 formed within the trench and the thin conductive film 34 are not relatively superjacent or subjacent, and the conductive material 34 comprises a high band gap and high thermal conductivity material of TiAlN (par. [0019]).

Regarding claim 36, Rodgers (Fig. 3E) discloses a memory cell, comprising: a layer of phase change material 37; and an elongated thin conductive film 34 having one end engaging a side of the layer 37 to define an interface 39 having a width and a height, wherein the thin conductive film and the layer of the phase change material engage at an interface and wherein the thin conductive film 34 has a thickness at the interface that is thinner than the phase change material 37 at the interface; an electrode 38 immediately adjacent the phase change material layer 37 and having a thickness extending away from the phase change material 37 in a plane substantially perpendicular to a longitudinal axis of the elongated thin conductive film 34. It is also noted that the process limitations recited in a "product by process" claim (determined

non-photolithographically, by thin film deposition parameters)) would not carry patentable weight in a claim drawn to structure because distinct structure is not necessarily produced. In re Thorpe, 227 USPQ 964 (Fed. Cir. 1985).

Regarding claims 37-38, because the width of the conductive film 34 generally parallel to the plane of the substrate and the height of the contact 38 generally normal to the film 34, the current flows from the interface into the phase change material layer 37 generally parallel to the film 34 and the current flows out of the layer 37 into the contact 37 generally normal to the film 34.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 7 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lung et al (US. 2004/0248339) in view of Ha et al (previously cited in IDS).

Regarding claims 7 and 34, Lung does not disclose that the phase change material layer 900 resides in a trench formed in the dielectric layer 400.

However, Ha (Fig. 1b) teaches the forming of a phase change material GST residing in a trench formed in the dielectric layer ILD. Accordingly, it would have been obvious to modify the memory cell of Lung by forming the phase change material layer 900 within a trench formed in the dielectric layer 400 because such forming of the phase

change material layer would provide the memory cell having a compact structure, as taught by Ha (see abstract paragraph).

6. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lung and Ha et al as applied to claim 7 above, and further in view of Lee et al (US. 6,806,528).

Neither Lung nor Ha discloses a transistor formed on the substrate and in the dielectric layer as claimed.

However, Lee's Fig. 3A teaches a transistor 120 formed on the substrate 100 and in the dielectric 250 and being electrically connected to a thin conductive film 260a. Accordingly, it would have been obvious to connect the thin conductive film 700 of Lung to a transistor formed on the substrate and in the dielectric in order to perform program and read operations of the phase-change memory device, as taught by Lee (column 10, lines 21-24).

7. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rodgers et al in view of Lee et al (US. 6,806,528).

Rodgers does not disclose a transistor formed on the substrate and in the dielectric layer as claimed.

However, Lee's Fig. 3A teaches a transistor 120 formed on the substrate 100 and in the dielectric layer 250 and being electrically connected to a thin conductive film 260a. Accordingly, it would have been obvious to connect the thin conductive film 34 of Rodgers to a transistor formed on the substrate and in the dielectric in order to perform program and read operations of the phase-change memory device, as taught by Lee (column 10, lines 21-24).

Allowable Subject Matter

8. Claims 9-11 are allowed.

See reasons of record.

Response to Arguments

9. Applicant's arguments with respect to the claimed invention have been considered but are moot in view of the new ground(s) of rejection.

The new references are applied in the new ground of rejections.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phat X. Cao whose telephone number is 571-272-1703. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

PC
February 5, 2007

PHAT X. CAO
PRIMARY EXAMINER